



# MEDI12001 Radiation Science

## Term 1 - 2024

Profile information current as at 10/05/2024 08:50 pm

All details in this unit profile for MEDI12001 have been officially approved by CQUniversity and represent a learning partnership between the University and you (our student). The information will not be changed unless absolutely necessary and any change will be clearly indicated by an approved correction included in the profile.

### General Information

#### Overview

This unit prepares you for the safe and effective use of ionising radiation for radiographic imaging in the simulated and clinical environment. The unit covers production and control of the radiation beam, radiation interactions in matter and risk of detriment to the human body from exposure to radiation. Radiation safety and dose minimisation practices are examined in light of current findings on detriment from low level radiation.

#### Details

Career Level: *Undergraduate*

Unit Level: *Level 2*

Credit Points: 6

Student Contribution Band: 8

Fraction of Full-Time Student Load: 0.125

#### Pre-requisites or Co-requisites

Pre-requisites: MEDI11001 Fundamentals of the Imaging Professions MEDI11002 Physics for Health Science ESSC11004 Study and Research Skills for Health Sciences

Important note: Students enrolled in a subsequent unit who failed their pre-requisite unit, should drop the subsequent unit before the census date or within 10 working days of Fail grade notification. Students who do not drop the unit in this timeframe cannot later drop the unit without academic and financial liability. See details in the [Assessment Policy and Procedure \(Higher Education Coursework\)](#).

#### Offerings For Term 1 - 2024

- Mackay

#### Attendance Requirements

All on-campus students are expected to attend scheduled classes – in some units, these classes are identified as a mandatory (pass/fail) component and attendance is compulsory. International students, on a student visa, must maintain a full time study load and meet both attendance and academic progress requirements in each study period (satisfactory attendance for International students is defined as maintaining at least an 80% attendance record).

#### Website

[This unit has a website, within the Moodle system, which is available two weeks before the start of term. It is important that you visit your Moodle site throughout the term. Please visit Moodle for more information.](#)

## Class and Assessment Overview

### Recommended Student Time Commitment

Each 6-credit Undergraduate unit at CQUniversity requires an overall time commitment of an average of 12.5 hours of study per week, making a total of 150 hours for the unit.

### Class Timetable

#### [Regional Campuses](#)

Bundaberg, Cairns, Emerald, Gladstone, Mackay, Rockhampton, Townsville

#### [Metropolitan Campuses](#)

Adelaide, Brisbane, Melbourne, Perth, Sydney

### Assessment Overview

#### 1. **Online Test**

Weighting: 40%

#### 2. **In-class Test(s)**

Weighting: 60%

### Assessment Grading

This is a graded unit: your overall grade will be calculated from the marks or grades for each assessment task, based on the relative weightings shown in the table above. You must obtain an overall mark for the unit of at least 50%, or an overall grade of 'pass' in order to pass the unit. If any 'pass/fail' tasks are shown in the table above they must also be completed successfully ('pass' grade). You must also meet any minimum mark requirements specified for a particular assessment task, as detailed in the 'assessment task' section (note that in some instances, the minimum mark for a task may be greater than 50%). Consult the [University's Grades and Results Policy](#) for more details of interim results and final grades.

## CQUniversity Policies

**All University policies are available on the [CQUniversity Policy site](#).**

You may wish to view these policies:

- Grades and Results Policy
- Assessment Policy and Procedure (Higher Education Coursework)
- Review of Grade Procedure
- Student Academic Integrity Policy and Procedure
- Monitoring Academic Progress (MAP) Policy and Procedure – Domestic Students
- Monitoring Academic Progress (MAP) Policy and Procedure – International Students
- Student Refund and Credit Balance Policy and Procedure
- Student Feedback – Compliments and Complaints Policy and Procedure
- Information and Communications Technology Acceptable Use Policy and Procedure

This list is not an exhaustive list of all University policies. The full list of University policies are available on the [CQUniversity Policy site](#).

## Previous Student Feedback

### Feedback, Recommendations and Responses

Every unit is reviewed for enhancement each year. At the most recent review, the following staff and student feedback items were identified and recommendations were made.

#### Feedback from Unit coordinator reflection SUTE

**Feedback**

Although attendance in tutorials is excellent, student engagement and participation in tutorial discussions are extremely poor.

**Recommendation**

Investigate options such as use of MS docs etc. to encourage student engagement and participation in tutorials.

#### Feedback from Unit coordinator reflection Informal student feedback

**Feedback**

Provision of breakdown of question types, marks and time budget in preparation for the tests were well received by students.

**Recommendation**

Continue with the provision of breakdown of question types, marks and time budget in preparation for the tests.

#### Feedback from Unit coordinator reflection Informal student feedback

**Feedback**

Provision of a practice test supported students in preparing for the in-class invigilated test.

**Recommendation**

Maintain the provision of a practice test to support students in preparing for the in-class invigilated test.

#### Feedback from Unit coordinator reflection Informal student feedback

**Feedback**

The first few weeks of the term have a larger volume of content which impacts on student engagement during these weeks.

**Recommendation**

Investigate the potential to adjust weekly content to balance out weekly volume across the term.

## Unit Learning Outcomes

### On successful completion of this unit, you will be able to:

1. Discuss the design, structure and operation of the x-ray tube in the production of x-radiation
2. Discuss the use of technical parameters, filters and collimation to control the useful x-ray beam's contents and dimensions
3. Apply underlying physical concepts in discussing the processes of x-ray photon production, x-ray interactions with matter and differential attenuation, in explaining the factors that affect each and in explaining the various metrics of radiation quantity and risk
4. Discuss current scientific understanding of the bioeffects and associated risks of radiation at the levels used in diagnostic radiology to body cells, tissues and systems across the lifespan
5. Discuss radiation safety regulations, legislation and associated best practice standards as they apply to occupational exposure and safe use of ionising radiation in diagnostic imaging.









This unit links to the following Professional Capabilities for Medical Radiation Practitioners as detailed by the Medical Radiation Practice Board of Australia (effective 1 March 2020):

- **Domain 1 (Medical Radiation Practitioner): Key capability 3 - Understand and apply the different methods of imaging and treatment** (Part b - Understand the modalities and equipment used in different imaging and treatment pathways across medical radiation practice)
- **Domain 1 (Medical Radiation Practitioner): Key capability 5 - Assess the patient's/client's capacity to receive care** (Part c - Identify patients/clients most at risk, including pregnant women and the foetus, breastfeeding mothers and their children)
- **Domain 2 (Professional and ethical practitioner): Key capability 1 - Practise in an ethical and professional manner, consistent with relevant legislation and regulatory requirements** - (Part a- Understand and comply with legal responsibilities)
- **Domain 5 (Radiation safety and risk manager): Key capability 1 - Perform and provide safe radiation practice** - (Part a- Comply with relevant radiation safety legislation, Part b - Practice in accordance with relevant radiation safety guidelines, Part c- Apply knowledge of radiobiology and medical radiation physics to examinations/treatment, Part d - Apply knowledge of radiobiology and radiation dose adjustment to deliver safe and effective patient/client outcomes, Part e - Review the referrals and associated examinations/treatment prescriptions to ensure appropriate justification, limitation and optimisation & Part f - Identify radiation risks and implement effective and appropriate risk management systems and procedures )
- **Domain 5 (Radiation safety and risk manager): Key capability 4 - Maintain safety of the workplace and associated environments** - (Part a- Identify safety hazards in the workplace and respond to incidents )including radiation and radioactivity incidents) in a timely and appropriate manner, in accordance with protocols and procedures, Part b - Report on all incidents (including radiation and radioactivity incidents) as needed, Part c - Manage the environmental risks of manufactured radiation and radioactivity, Part d - Identify, confirm and implement methods of radiation management, Part e - Use safe and legal methods for managing manufactured radiation sources, including using appropriate personal protective clothing and equipment and complying with shielding requirements, Part f - Use safe and legal methods for storing and disposing radioactive material and identify and minimise occupancy risks about proximity of radiation and radioactive storage. g. Provide information on radiation-related hazards and control measures to others in the workplace).

## Alignment of Learning Outcomes, Assessment and Graduate Attributes

 N/A Level	 Introductory Level	 Intermediate Level	 Graduate Level	 Professional Level	 Advanced Level
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### Alignment of Assessment Tasks to Learning Outcomes

Assessment Tasks	Learning Outcomes				
	1	2	3	4	5
1 - Communication					
2 - Problem Solving					
3 - Critical Thinking					
4 - Information Literacy					
5 - Team Work					
6 - Information Technology Competence					
7 - Cross Cultural Competence					
8 - Ethical practice					
9 - Social Innovation					
10 - Aboriginal and Torres Strait Islander Cultures					

## Textbooks and Resources

### Textbooks

MEDI12001

#### Supplementary

##### **Essentials of Radiographic Physics and Imaging**

Edition: 2nd (2015)

Authors: Johnston JN & Fauber TL

Elsevier

St Louis , Missouri , USA

ISBN: 9780323339674

Binding: eBook

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#### Supplementary

##### **Radiography in the Digital Age**

Edition: 3rd (2018)

Authors: Carroll, Quinn B

Charles C Thomas Publisher Ltd

Springfield , Illinois , USA

ISBN: 9780398092153

Binding: eBook

#### Additional Textbook Information

The text by Carroll will be used regularly in multiple second year units: MEDI12001 Radiation Science, MEDI12002 Science & Instrumentation 1 and MEDI12005 Science & Instrumentation 2. It is freely available online through the unit eReading List. The eBook version of this text can be purchased through the publisher's website [https://www.ccthomas.com/details.cfm?P\\_ISBN13=9780398092146](https://www.ccthomas.com/details.cfm?P_ISBN13=9780398092146).

The text by Johnston and Fauber may be used at times and will be available through the CQUniversity Library (hardcopy) & unit eReading List (online).

### IT Resources

#### **You will need access to the following IT resources:**

- CQUniversity Student Email
- Internet
- Unit Website (Moodle)

## Referencing Style

All submissions for this unit must use the referencing style: [Vancouver](#)  
For further information, see the Assessment Tasks.

## Teaching Contacts

**Reshmi Kumar** Unit Coordinator  
[r.d.kumar@cqu.edu.au](mailto:r.d.kumar@cqu.edu.au)

## Schedule

### **Week 1 - 04 Mar 2024**

Module/Topic

Chapter

Events and Submissions/Topic

**X-ray production: Part 1**

- Introduction to x-ray tube circuitry
- Key external structures of the x-ray tube
- Key internal structures of x-ray tube
- X-ray tube operation

"Radiography in the Digital Age" - selected readings from Chapters 8 & 9.  
 "Essentials of Radiographic Physics & Imaging" - Chapters 2, 4 & 5.  
 • Refer to Moodle for specific pages and any additional readings.

**Tutorial 1****Week 2 - 11 Mar 2024****Module/Topic****Chapter****Events and Submissions/Topic****X-ray production: Part 2**

- Review of Physics foundation concepts associated with x-ray production
- Heat production at the anode
- Characteristic radiation production
- Bremsstrahlung radiation production

"Radiography in the Digital Age" - selected readings from Chapters 4 & 10.  
 "Essentials of Radiographic Physics & Imaging" - Chapter 6.  
 • Refer to Moodle for specific pages and any additional readings.

**Tutorial 2****Week 3 - 18 Mar 2024****Module/Topic****Chapter****Events and Submissions/Topic****X-ray spectrum and factors affecting it**

- Spectral curves
- Technical parameters
- Collimation

"Radiography in the Digital Age" - selected readings from Chapters 3, 10, 15, 16 & 18.  
 "Essentials of Radiographic Physics & Imaging" - Chapter 6.  
 • Refer to Moodle for specific pages and any additional readings.

**Tutorial 3****Week 4 - 25 Mar 2024****Module/Topic****Chapter****Events and Submissions/Topic****Interaction of x-rays with matter**

- Compton scattering
- Photoelectric effect
- Factors affecting probability of interactions of x-rays with matter

"Radiography in the Digital Age" - selected readings from Chapters 11 & 12.  
 "Essentials of Radiographic Physics & Imaging" - Chapter 7.  
 • Refer to Moodle for specific pages and any additional readings.

**Tutorial 4****Week 5 - 01 Apr 2024****Module/Topic****Chapter****Events and Submissions/Topic****X-ray beam attenuation**

- Exponential attenuation, HVL and beam hardening
- Filtration (inherent, added & compensating)
- Anode heel effect (self-filtration)

"Radiography in the Digital Age" - selected readings from Chapters 17 & 21.  
 "Essentials of Radiographic Physics & Imaging" - Chapters 5 & 6.  
 • Refer to Moodle for specific pages and any additional readings.

**Tutorial 5****Vacation Week - 08 Apr 2024****Module/Topic****Chapter****Events and Submissions/Topic**

Break week

**Week 6 - 15 Apr 2024****Module/Topic****Chapter****Events and Submissions/Topic**

Assessment week

No new content taught.

**No tutorial.**

**Online Test** Due: Week 6 Monday (15 Apr 2024) 10:30 am AEST

**Week 7 - 22 Apr 2024****Module/Topic****Chapter****Events and Submissions/Topic**

### Radiosensitivity and radiation risk

- Radiosensitivity classification of cell and tissue type
- Physical and biological factors affecting radiation response
- Radiation dose-response relationships
- Risk models
- Metrics of radiation quantity and risk
- Stochastic versus tissue reactions

"Radiography in the Digital Age" - selected readings from Chapters 39, 40 & 41.  
• Refer to Moodle for specific pages and any additional readings.

### Tutorial 6

#### Week 8 - 29 Apr 2024

Module/Topic	Chapter	Events and Submissions/Topic
<b>Radiation effects at cellular level, on the body systems and the body</b> <ul style="list-style-type: none"><li>• Review of mitosis process</li><li>• Target theory: Direct and indirect effects of radiation</li><li>• Radiolysis of water</li><li>• Effects of excitation and ionisation at cellular level</li><li>• Effects of radiation on DNA</li><li>• Early and late effects of radiation</li></ul>	"Radiography in the Digital Age" - selected readings from Chapters 40 & 41. • Refer to Moodle for specific pages and any additional readings.	<b>Tutorial 7</b>

#### Week 9 - 06 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
<b>Hereditary and congenital effects of radiation</b> <ul style="list-style-type: none"><li>• Review of meiosis and gamete production</li><li>• Effect of radiation on different developmental stages of pregnancy</li><li>• Current perspectives on radiation risks in pregnancy</li></ul>	"Radiography in the Digital Age" - selected readings from Chapters 41. • Refer to Moodle for specific pages and any additional readings.	<b>Tutorial 8</b>

#### Week 10 - 13 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
<b>Radiation protection</b> <ul style="list-style-type: none"><li>• Cardinal principles of radiation protection</li><li>• ALARA principle</li><li>• Leakage radiation</li><li>• Radiographic features in modern x-ray imaging systems</li><li>• Primary versus secondary radiation barriers</li><li>• Factors governing adequacy of radiation barriers</li></ul>	"Radiography in the Digital Age" - selected readings from Chapters 42. • Refer to Moodle for specific pages and any additional readings.	<b>Tutorial 9</b>

#### Week 11 - 20 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
<b>Radiation dose management</b> <ul style="list-style-type: none"><li>• Radiation detection and management</li><li>• Occupational versus public radiation exposure</li><li>• Dose comparisons for imaging procedures and modalities</li><li>• Regulation and legislation on radiation protection</li><li>• Recent developments in clinical radiation protection practices</li><li>• Reducing unnecessary patient dose, including pregnant patients.</li></ul>	"Radiography in the Digital Age" - selected readings from Chapters 42. • Refer to Moodle for specific pages and any additional readings.	<b>Tutorial 10</b>



## Week 12 - 27 May 2024

Module/Topic	Chapter	Events and Submissions/Topic
Consolidation and revision		<b>Tutorial 11</b>

## Review/Exam Week - 03 Jun 2024

Module/Topic	Chapter	Events and Submissions/Topic
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## Exam Week - 10 Jun 2024

Module/Topic	Chapter	Events and Submissions/Topic
		<b>In-Class Test</b> Due: Exam Week Monday (10 June 2024) 1:00 pm AEST

## Term Specific Information

This unit is designed to be taken concurrently with MEDI12002 Science & Instrumentation 1 and content from that unit will be referred to and used to develop understanding of the content in this unit. You are expected to spend an average 10-12 hours of time each week in your study activities for this unit. A suggested budget for weekly study is:

- 2 hours for watching lecture recordings and taking notes
- 1.5 - 2 hours for completing assigned readings
- 0.5 - 1 hour for completing other posted learning activities
- 2 hours for creating study notes to meet weekly learning goals using lectures and readings
- 1 - 1.5 hours for working on posted tutorial questions in preparation for tutorial
- 1.5 hours for participation in tutorial
- 1 - 2 hours for preparation and/or revision for online tests

Tutorials are interactive sessions where your participation enables you to check your understanding of and your ability to apply the week's concepts and for you to build your skills in responding to test questions. Your regular and active participation strongly supports your success in the unit.

## Assessment Tasks

### 1 Online Test

#### Assessment Type

Online Test

#### Task Description

You will complete an online test on **Monday 15 April 2024 in Week 6**. This test will be available from 9:00am to 10:30am AEST. The test is a timed test that will begin once you've opened it, and will be for a duration of 60 minutes, closing automatically when the 60 minutes is up. The aim of the test is for you to demonstrate your ability to apply concepts and terminology from Weeks 1-5 of the unit. All questions will be based on the posted weekly learning goals. The question tasks will be of similar type to those discussed in weekly tutorials and will require you to apply your knowledge and understanding rather than to simply recall facts. These tasks may include analysis of diagrams and photographs to explain and discuss concepts. There will be a mixture of problem solving and application of concepts type questions.

**This is an open book test.** It means that during the test you may access your study notes, textbook, the unit Moodle site and/or any website. **The standards of academic integrity still apply.** All responses must be your own work. Colluding with other students on non-group work is considered academic misconduct. Just as for written assignments, you must acknowledge intellectual content in your answers that is not your own work. Basic statements of facts are considered 'common knowledge' in the context of this unit so they do not need to be cited. *However, if you copy any explanation content word-for-word from ANY source, you must put that content in quotation marks and formally cite your source.* Although this is an open book test, the expectation is that you will be familiar with the unit content and concepts. You should not assume you will have time to look up the answer to every question.

As per the assessment Procedures, this test must be written at the timetabled date and time. **There is no opportunity to apply a late penalty. In the absence of an approved extension, you cannot complete this assessment at**

**a later time and you will receive a mark of zero for the assessment if you have not submitted it by the scheduled date and time. If you start the test late, you will still be required to submit at the stated closing time.**

#### **Assessment Due Date**

Week 6 Monday (15 Apr 2024) 10:30 am AEST

#### **Return Date to Students**

Week 8 Monday (29 Apr 2024)

#### **Weighting**

40%

#### **Assessment Criteria**

Question responses will be scored on the following criteria:

- correct use of terminology
- correct selection and application of core concepts to the specific content of the question
- clarity, correctness, relevance and completeness of the response in addressing the question that was asked
- critical thinking

The number of marks for each question are allocated based on the depth and breadth of the required response, and will be indicated on the online test.

#### **Referencing Style**

- [Vancouver](#)

#### **Submission**

Online

#### **Learning Outcomes Assessed**

- Discuss the design, structure and operation of the x-ray tube in the production of x-radiation
- Discuss the use of technical parameters, filters and collimation to control the useful x-ray beam's contents and dimensions
- Apply underlying physical concepts in discussing the processes of x-ray photon production, x-ray interactions with matter and differential attenuation, in explaining the factors that affect each and in explaining the various metrics of radiation quantity and risk

## **2 In-Class Test**

#### **Assessment Type**

In-class Test(s)

#### **Task Description**

Take note that this is a closed-book supervised test. You will complete an in-class, closed-book, online Moodle test on **Monday 10th June 2024 in Week 14 (Exam week)** to demonstrate your ability to apply concepts and terminology learned in the unit.

This test will allow you to demonstrate your knowledge of, and ability to apply the concepts and use the terminology from all weeks of the unit, with an emphasis on Weeks 7-11. All questions will be based on the posted weekly learning goals and may include analysis of diagrams, photographs and/or radiographs. Questions may include quiz-style questions (for example multiple choice, fill-in-the-blank, matching), true/false with explanation and written response. The question tasks will be of similar type to those discussed in weekly tutorials and will require you to apply your knowledge and understanding, rather than to simply recall facts.

**This is a 90 minute test.** You will sit this test at your timetabled assessment time on the due date. There are two back-to-back sittings of this test so your test start and end time will depend on your registered session. You should be in attendance at your allocated room at the start of your registered session. Further instructions will be provided in Moodle.

This test must be written at the timetabled date and time. As per the Assessment Procedures, this task is to be completed during a defined period. There is no opportunity to apply a late penalty. If you arrive late, you may enter the test room up to 30 minutes after the start of the test; however, you will still be required to submit your test at the standard test end time. You will not be allowed entry more than 30 minutes after the test starts. In the absence of an approved extension, you cannot complete this assessment at a later time, and you will receive a mark of zero for the assessment if you have not completed it by the scheduled date and time. If you have an approved extension, you will be assigned a new test date and time as soon as possible after the original test date, according to availability of a test

supervisor and an appropriate room. It is your responsibility to ensure that you can attend at that new assigned date/time. Please see Section 5 of the the University's Assessment Policy and Procedure for details regarding Assessment Management, specifically around assessment extension.

**Assessment Due Date**

Exam Week Monday (10 June 2024) 1:00 pm AEST

**Return Date to Students**

Feedback and test results will be available 2 weeks after date of test.

**Weighting**

60%

**Minimum mark or grade**

50%

**Assessment Criteria**

Question responses will be scored on the following criteria:

- correct use of terminology
- correct selection and application of core concepts to the specific content of the question
- clarity, correctness, relevance and completeness of the response in address the question that was asked
- critical thinking

The number of marks for each question are allocated based on the depth and breadth of the required response, and will be indicated on the online test.

**Referencing Style**

- [Vancouver](#)

**Submission**

Online

**Learning Outcomes Assessed**

- Discuss the design, structure and operation of the x-ray tube in the production of x-radiation
- Discuss the use of technical parameters, filters and collimation to control the useful x-ray beam's contents and dimensions
- Apply underlying physical concepts in discussing the processes of x-ray photon production, x-ray interactions with matter and differential attenuation, in explaining the factors that affect each and in explaining the various metrics of radiation quantity and risk
- Discuss current scientific understanding of the bioeffects and associated risks of radiation at the levels used in diagnostic radiology to body cells, tissues and systems across the lifespan
- Discuss radiation safety regulations, legislation and associated best practice standards as they apply to occupational exposure and safe use of ionising radiation in diagnostic imaging.

## Academic Integrity Statement

As a CQUniversity student you are expected to act honestly in all aspects of your academic work.

Any assessable work undertaken or submitted for review or assessment must be your own work. Assessable work is any type of work you do to meet the assessment requirements in the unit, including draft work submitted for review and feedback and final work to be assessed.

When you use the ideas, words or data of others in your assessment, you must thoroughly and clearly acknowledge the source of this information by using the correct referencing style for your unit. Using others' work without proper acknowledgement may be considered a form of intellectual dishonesty.

Participating honestly, respectfully, responsibly, and fairly in your university study ensures the CQUniversity qualification you earn will be valued as a true indication of your individual academic achievement and will continue to receive the respect and recognition it deserves.

As a student, you are responsible for reading and following CQUniversity's policies, including the [Student Academic Integrity Policy and Procedure](#). This policy sets out CQUniversity's expectations of you to act with integrity, examples of academic integrity breaches to avoid, the processes used to address alleged breaches of academic integrity, and potential penalties.

### What is a breach of academic integrity?

A breach of academic integrity includes but is not limited to plagiarism, self-plagiarism, collusion, cheating, contract cheating, and academic misconduct. The Student Academic Integrity Policy and Procedure defines what these terms mean and gives examples.

### Why is academic integrity important?

A breach of academic integrity may result in one or more penalties, including suspension or even expulsion from the University. It can also have negative implications for student visas and future enrolment at CQUniversity or elsewhere. Students who engage in contract cheating also risk being blackmailed by contract cheating services.

### Where can I get assistance?

For academic advice and guidance, the [Academic Learning Centre \(ALC\)](#) can support you in becoming confident in completing assessments with integrity and of high standard.

### What can you do to act with integrity?



#### Be Honest

If your assessment task is done by someone else, it would be dishonest of you to claim it as your own



#### Seek Help

If you are not sure about how to cite or reference in essays, reports etc, then seek help from your lecturer, the library or the Academic Learning Centre (ALC)



#### Produce Original Work

Originality comes from your ability to read widely, think critically, and apply your gained knowledge to address a question or problem